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BENTHIC BIOLOGY. LITTLE KANAWHA RIVER BASIN, WEST VIRGINIA

Federal Water Pollution Control
Administration
Wheeling, West Virginia

January 1968

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BENTHIC BIOLOGY
LITTLE KANAWHA RIVER BASIN

WEST VIRGINIA

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BENTHIC BIOLOGY

LITTLE KANAWHA RIVER BASIN

West Virginia

Work Document No. 13

Aquatic Biology Unit
Laboratory Services Section
Wheeling Field Station
Ohio River Basin Project

OHIO BASIN REGION
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
UNITED STATES DEPARTMENT OF THE INTERIOR

JANUARY 1968

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I. INTRODUCTION

Objectives and Scope of Study

The Wheeling Field Station of the Ohio River Basin Comprehensive Project, Federal Water Pollution Control Administration conducted a water quality study of the Little Kanawha River basin during 1964. The Field Station performed physical, chemical and biological analyses and observations throughout the drainage area. This report deals with the biological studies conducted as a part of the Little Kanawha investigation.

The objectives of the biological study are (1) to define the aspects of pollution prior to intensive chemical appraisal of the water quality and (2) to establish a "base-line" of present biological conditions against which future changes can be measured.

The intent of this report is to document the results of the biological study and to function as a planning aid for water quality studies in the Little Kanawha River basin.

The aquatic biology survey provides an analysis of the water quality in a given stream or section of stream. The biological data and descriptions delineate the areas capable of supporting aquatic organism associations typical of non-polluted water from those aquatic communities exhibiting a disrupted or altered biota. An altered community indicates environmental changes such as occur with pollution of the habitat.

The results of this survey and related observations, together with other basic information, constitute a base for the planning, formation and execution of water quality surveys incorporating other scientific and engineering disciplines.

The effects of pollution on aquatic life can be dramatic, as for example, the occurrence of a fish kill. The effects can also be demonstrated in more subtle ways. The effects of pollution on organisms have been presented with the use of varying techniques and demonstrations by aquatic biologists in numerous water pollution reports. The use of biological phenomena in assessing water quality is an established and accepted methodology employed by water pollution investigating agencies. Homogeneously, this report presents the findings of the studies conducted in the Little Kanawha River basin in 1964.

Figure 1 is a drainage map of the Little Kanawha basin. The Little Kanawha River is approximately 165 miles long and flows in a northwesterly direction to the Ohio River at Parkersburg, West Virginia. The headwaters are at an elevation of about 2,050 feet above sea level; at Burnsville, only 44 miles downstream, the river is at 750 feet. The rate of fall in this stretch is 29.5 feet per mile. The elevation at the mouth at Parkersburg, 121 miles downstream from Burnsville, is 572 feet, the fall in this stretch being only about 1.5 feet per mile or about one-twentieth the slope in the headwater region.

The basin lies entirely within the Appalachian Plateaus province and, except along the Ohio River and lower Little Kanawha River where broad floodplains and terraces are the distinctive features, the basin displays the high hills, steep slopes and absence of flat land that characterize the province. Parkersburg and its suburbs are situated on a broad lowland at the juncture of the Ohio and Little Kanawha Rivers. Area of the Little Kanawha basin is 2,309 square miles which is slightly less than 10 percent of the area of the State of West Virginia.

Much of the basin is covered by second growth timber. A small quantity of coal is mined in the eastern part of the basin and oil and gas are produced. Farming is the principal occupation. The basin is sparsely populated and all population is classed urban and rural. Spencer, having a population of 2,660 in 1960, is the largest town and only urban area in the basin. There are only 13 other incorporated towns in the basin, seven of which have a population of over 500.

The Hughes River with its two forks is the principal tributary. It enters the Little Kanawha below Elizabeth near Slate, nineteen miles from its mouth. Other major tributaries are the West Fork and Steer Creek.

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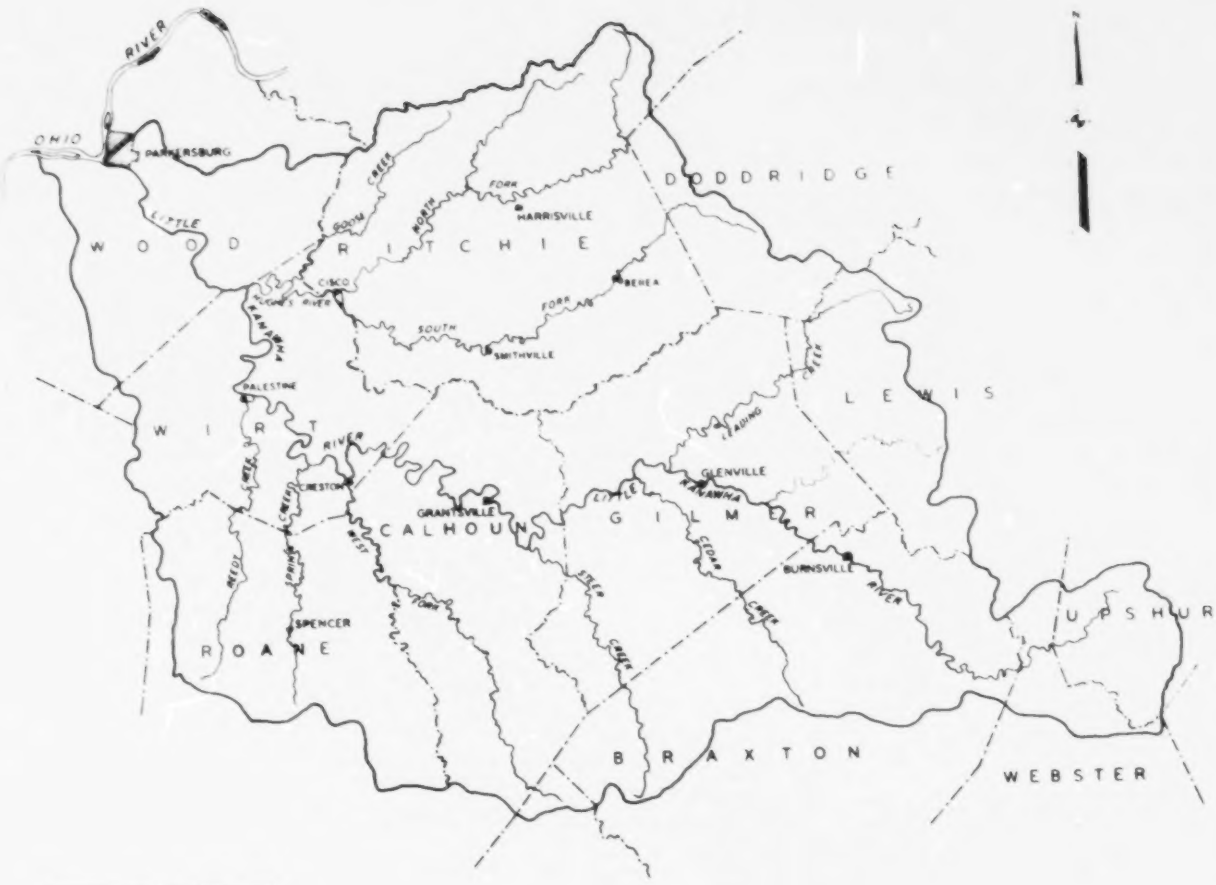

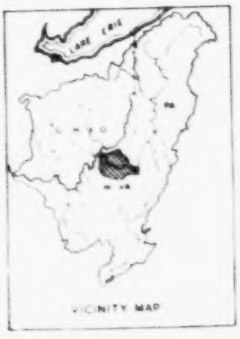

SCALE 0 5 10 20 30 MILES

LITTLE KANAWHA RIVER BASIN

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OHIO BASIN REGION - WHEELING FIELD STATION

FIGURE 1

II. SUMMARY OF FINDINGS

The benthic fauna of the Little Kanawha River basin, for the majority of the stations sampled, was representative of water free of pollution. Sensitive benthic organisms were collected at all but two locations. The benthos of the Little Kanawha River near its mouth and below Grantsville was dominated by tolerant forms. The benthos of Spring Creek below Spencer also had a predominance of tolerant forms.

The Little Kanawha basin streams are subject to excessive amounts of silt loads. The relatively low total numbers and numbers of varieties may be attributed to siltation. Silted substrates favor the development of the tolerant organisms. The benthic data from the North and South Forks of Hughes River and Leading Creek reflected this condition.

The Little Kanawha River benthic data indicated domestic waste pollution below Grantsville, West Virginia. Degradation of the stream habitat occurred in the Little Kanawha River near its mouth at Parkersburg. A chemical plant is located upstream of the sampling location. The benthos of the remainder of the Little Kanawha River stations was typical of unpolluted water.

The benthos of Spring Creek below Spencer, West Virginia, was composed of tolerant forms, typical of habitats polluted by domestic waste.

The Cedar Creek benthos was dominated by tolerant forms but sensitive forms were also present. The standing crop was low but the number of varieties was not considered low. Cedar Creek has had fish kills attributable to mining operations.

There were several small tributaries (Copen, Lynch, Bear and Stewart Runs) of the Little Kanawha that had been polluted by mine drainage. However, the flow contributed by these tributaries was small and had little effect on the main stem.

Present and future pollution problems in the Little Kanawha River basin, as indicated by the benthic data and observations, are: siltation, coal mining activity, oil wells and pipelines, and domestic waste problems below Grantsville, Spencer and other small communities.

Additional fish kills can be expected, unless pollution abatement occurs, on Reedy Creek below a lumber treatment plant and on the Little Kanawha River below a chemical plant at Parkersburg.

III. METHODS AND TECHNIQUES

Benthos Role in Water Pollution Surveys

The primary objective of a biological survey as part of the comprehensive project is to determine the water quality using aquatic organisms as an index. The role of benthic organisms in the study of water pollution has been well documented.

The biological characterizations of any given stream are readily accomplished by a study of the macro-invertebrate fauna. The aquatic community includes three major groups: the nekton or free swimmers, the plankton or drifters, and the benthos or bottom associated organisms. Since fish are transient in nature and plankton are moved about by currents, the benthos is best suited for study to determine prevailing water quality conditions. Bottom dwelling organisms exhibit a pronounced response to pollution, have a sufficiently long life cycle to prevent response to intermittent relief from pollution, and lack a means of rapid locomotion thus prohibiting extended migrations. Because of these qualities, bottom-dwelling organisms reflect conditions at the sampling point for an extended period of time.

Field and Laboratory Techniques

Whenever possible, samples are collected from riffle areas. It has been demonstrated that the degree and extent of pollution in a stream can be determined accurately by reference to the macro-invertebrate fauna, particularly that found in the riffles. Also particulate organic matter and silt tend to settle out in pools creating an unfavorable habitat. Samples collected from such areas do not often reflect the true condition of the stream.

The number of samples collected at any one station is left to the judgment of the biologist. Generally, two to three cross section samples per station (or sample site) are collected, depending on the size of the stream. Published reports have shown that only two square-foot samples are necessary to be reasonably certain of obtaining representatives of the principal groups of organisms present.

Samples are collected with the Surber sampler, Petersen dredge or Ekman dredge depending on the habitat or substrate at the sampling point. The material collected is washed, sieved (when collected with a dredge), and placed in quart jars with preservative. The samples are transported to the station laboratory for enumeration and identification of the aquatic organisms. All organisms are identified to the family taxonomic level, with the exception of the sludge worms which are identified only to the class taxonomic level. The individual groups of organisms are classed as sensitive, tolerant and very tolerant based upon their response to pollution. This classification is based on known tolerances of various groups as reported in the literature, and upon personal observations of various benthic associations encountered in both polluted and unpolluted waters.

IV. RESULTS OF BENTHIC SAMPLING

A total of 19 stations were established and studied throughout the Little Kanawha River basin. Table 1 lists the location and physical description of each station. Figure 3, at the terminus of this report shows the station locations and types of samples collected during the study. Quantitative benthic samples were collected at 16 of the 19 stations. The remainder were examined qualitatively.

The physical composition, as described in Table 1, of the substrate and habitat available affects the number and kinds of organisms present. A knowledge of the habitat normally occupied by various organisms and the effect of habitat changes upon these organisms is as important as the direct effects of water quality changes. Recognition of this ecological principle is important to the conclusions developed for a particular section of stream. The benthic association observed and the habitat analysis must both be given equal consideration when evaluating the pollutional status of a given area.

Table 2 lists the organism composition of each station sampled. The table includes the stream, station number, number of square foot samples collected, number of individuals for each taxonomic group collected, total number of organisms collected, average number per square foot, number of varieties, and percentages of pollution tolerant groups. These percentages were based on the number of individuals occurring in each group.

The pollution tolerant groups, for demonstration purposes, are called Class I, II and III. The tolerance groups, as defined for this report are: I) sensitive, or organisms unable to withstand polluted conditions; II) tolerant, or organisms capable of withstanding moderate amounts of pollution and III) very tolerant, or organisms with the capability to withstand severe polluted conditions. The tolerant and very tolerant groups have a wide range of tolerance levels, and with increased pollution these groups are able to replace the sensitive forms in the biota.

The variety diversity and percentages of the tolerance groups are represented in Figure 2 by bar graphs and histograms respectively. These graphic figures are shown for each station on a schematic drawing of the Little Kanawha River sub-basins. It is noted that a reduction in the number of varieties generally is accompanied by an increase in the percentage of tolerant and very tolerant forms.

Six stations were sampled on the main stem of the Little Kanawha River. At the majority of stations, both the number of organisms and varieties were low. Only at station 7 (below Grantsville) was the number of organisms per square foot high. A degraded condition exists here due to sewage effluent from the town of Grantsville. The percentage composition at this location was 7% sensitive, 68% tolerant, and 25% very tolerant. The varieties of organisms found per station increased

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slightly from the uppermost station at Burnsville (1) to Creston (9) where they reached their maximum number of seven. The variety declined to a minimum of one near the mouth of the Little Kanawha River. The number of organisms per square foot was a maximum at Grantsville and a minimum near the mouth.

With the exception of stations at Grantsville (7) and at the mouth (19), the aquatic biota of the Little Kanawha River was indicative of water free of pollution. The benthos at stations 1, 4, 9 and 18 was dominated by pollution sensitive forms. Figure 2 graphically portrays these benthic compositions. Station 7 at Grantsville indicated degradation due to sewage effluent from the town of Grantsville. Coal fines were observed in the stream at this point. Coal washery settling ponds are located in the upstream drainage.

A degraded habitat was found from Lock No. 1 to the mouth of the river, a distance of approximately 3 3/4 miles. The substrate throughout this section, with the exception of the area near the dam, was composed mostly of clay which was covered by a heavy black sludge. Only sludge worms (Oligochaeta) were collected. Much of the stream bottom in this section of river was devoid of life. This section of the river receives waste materials from a chemical industry in Parkersburg.

The sparse fauna found in the Little Kanawha at the stations supporting clean water benthic communities may be due to several factors. The soil types of the Little Kanawha watershed are easily eroded to produce silt loads in the drainage system. Low standing crops of organisms in the upper reaches of the river may be attributed to both siltation and low water fertility. Further, the sampling program was conducted during the fall of the year when the biomass might be expected to be reduced. It is important to note, however, that even with reduced standing crops the tolerance group ratios are measurable.

Ten samples were collected from tributary streams and observations made on two others. In general, the standing crop of organisms per tributary station was higher than main stem stations ranging from a low of 13 per square foot on the West Fork to a high of 181 per square foot on Reedy Creek. The number of varieties was also higher, ranging from a high of 12 on Reedy Creek to a low of three on Spring Creek (See Figure 2).

The majority of the tributary streams sampled supported a variety of organisms indicating water free of pollution. There were exceptions at which the biota reflected degraded conditions. Spring Creek below Spencer (10) supported a biota indicative of domestic pollution. The stream recovered sufficiently near its mouth to support a number of sensitive forms. Stations at which semi-healthy conditions existed were Oil Creek (2), Leading Creek (5), Cedar Creek (6), South Fork Hughes (13 and 14), and North Fork Hughes (15). Water quality at these stations appeared to be suitable, but the sensitive forms had been depressed due to siltation, and/or mine drainage. Such conditions usually favor the more tolerant forms of organisms. Cedar Creek has been subjected to periodic mine drainage. Sensitive forms were found at all of the tributary stations except at the Spring Creek location below Spencer (10).

V. GENERAL DISCUSSION OF FISH LIFE

Although fish studies were not conducted by project personnel in this study, a general discussion drawn from state agency reports is offered.

The Little Kanawha River Valley contains some 81 fishing streams containing four or more miles of fishable water with a total fishable water length of 1,027 miles.

The river has a fine fishing reputation and each year muskies up to 35 pounds are taken from its waters. The West Virginia state record flathead catfish (a 70 pound fish) was caught in the Little Kanawha.

The muskellunge is the most important game fish. It is found in the main stem to Falls Mill and in the major tributaries. Smallmouth bass are abundant in most streams of the drainage and the main stem in the rocky, high gradient sections. The spotted bass and crappie are abundant in the large pools of the main stem and several species of catfish are found throughout the drainage with the large flathead confined to the larger waters. Minnows and rough fish are common in all streams.

Presently 58 species of fish are known to occur in the basin. This includes all major sport fish including trout which are stocked in several head water streams. The only game fish of any importance not found in the basin is the walleye.

Fish Kills

Since 1964 seven pollution caused fish kills have been reported in the Little Kanawha basin killing 59,868 fish. These kills have occurred on only four streams. The largest kills were on Reedy Creek where 56,368 fish were reported killed on three separate occasions. All kills were in the vicinity of Reedy and have been attributed to a lumber treatment plant. Two kills were reported on the Little Kanawha River and one on Cedar Creek. Several kills have occurred for which no data is available. Kills occur yearly on the Little Kanawha River at Parkersburg and are the results of heavy organic waste loads and toxic materials from a chemical plant upstream of the mouth of the Little Kanawha. Table 3 gives data for fish kills reported during the years 1964 through 1966.

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TABLE 1 STATION DESCRIPTION - Little Kanawha River Basin

STATION	STA. NO.	SAMPLING AREA	TYPE SAMPLER	DEPTH (In Feet)	SUBSTRATE	BENTHIC FAUNA PREDOMINANCE SEN.	TOL.	V. TOL.	COMMENTS
Little Kanawha River Above Burnsville	1	R	S	.5	Rock Gravel Sand	X	-		Shifting Gravel Bottom
Oil Creek Below Burnsville	2	R	Q	.5	Rock Silt	X			Rocks Covered With Silt
Copen Run @ Gilmer Station	3	R	Q						Evidence of Acid Pollution
Little Kanawha Below Glenville	4	R	S	.7	Gravel Sand	X	-		
Leading Creek Above Mouth	5	P	P	1	Gravel Sand	X	X	-	Shifting Gravel Substrate
Cedar Creek @ State Park	6	R	S	.5	Gravel Sand Silt	-	X	-	Subject to Acid Mine Pollution
Little Kanawha Below Grantsville	7	P	P	1	Rock Gravel Silt	-	X	X	Coal Fines Evident in Stream
West Fork of Little Kanawha @ Creston	8	R	S	1	Rock Gravel Sand	X	-	-	Considerable Siltation Organisms Sparse
Little Kanawha Below Creston	9	R	S	.5	Rock Gravel	X	X	-	
Spring Creek Below Spencer	10	R	S	.5	Rock Gravel Sludge		X	X	Organic Pollution
Spring Creek Near Mouth	11	R	Q	1	Gravel Sand	X			
Reedy Creek Above Palestine	12	R	S	.5	Gravel Rock Silt	X	X	-	
South Fork Hughes @ Berea	13	R	S	.5	Rock Gravel Sand	X	X	-	

TABLE 1 (continued) STATION DESCRIPTION - Little Kanawha River Basin.

STATION	STA. NO.	SAMPLING AREA	TYPE SAMPLER	DEPTH (In Feet)	SUBSTRATE	BENTHIC FAUNA PREDOMINANCE SEN.	TOL.	V. TOL.	COMMENTS
South Fork Hughes @ Smithville	14	P	P	1	Gravel Sand Silt	-	X	X	Oil Slick On Surface
North Fork Hughes Above Cisco	15	P	P	.5	Gravel Sand	-	X	X	
Hughes River Below Cisco	16	R	S	.5	Gravel	X	-	-	
Goose Creek Above Mouth	17	R	S	.5	Gravel	X	X	-	
Little Kanawha @ Leachtown	18	R	S	.5		X	X		Heavy Silt
Little Kanawha Above Mouth	19	P	E	.8	Sludge			X	Heavy Industrial Pollution

KEY

Sampling Area:

P = Pool
R = Riffle

Type Sampler:

P = Petersen dredge
E = Ekman dredge
S = Surber square foot
Q = Qualitative sample

Predominance:

Sen. = Sensitive
Tol. = Tolerant
V. Tol. = Very Tolerant

X = Major Predominance
X = Present
- = Trace

A

TABLE 2. CLASSIFICATION and COMPOSITION of BENTHIC SAMPLES, LITTLE KANAWHA

LITTLE KANAWHA BASIN	Station Number	Number of Samples	CLASS I												CLASS II					
Stations	LK		Caddisflies Hydropsychidae	Philonotanidae	Leptoceridae	Mayflies Baetidae	Heptagenidae	Ephemeridae	Helgrammites Corydalidae	Biting Midge Ceratopogonidae	Gill Snails Ctenobranchiata	Clams Unionidae	Beetle Larva Elmidae	Damselflies Coenagrionidae	Fingernail Clams Sphaeriidae	Snails Pulmonata	Crayfish Astacidae	Flatworms Planariidae	Crane Flies Tipulidae	Midge Flies
Little Kanawha River	1	1	4			1	1						1				1			
Little Kanawha River	4	2	16	1			10								1	1				
Leading Creek	5	2	15			3	11						1	5	2					1
Cedar Creek	6	2	4	2									1	1	10	10	1	36		
Little Kanawha River	7	2						8		4		1								1
West Fork of Little Kanawha River	8	1	2			1	8							1						
Little Kanawha River	9	2	47			5	10						10	1						
Spring Creek	10	1																2		
Reedy Creek	12	1	92	1	1	8	17		1				17		31				2	
South Fork of Hughes River	13	1	1			5	12								35		1			
South Fork of Hughes River	14	2				10	3								2	2	2			
North Fork of Hughes River	15	1	1			1	3								41	3			1	
Hughes River	16	1	97			2	4		1		5					1				

D

COMPOSITION of BENTHIC SAMPLES, LITTLE KANAWHA RIVER BASIN

Hellgrammites Corydalidae	Biting Midge Ceratopoponidae	Gill Snails Ctenobranchiata	Clams Unionidae	Beetle Larva Elmidae	Damselflies Coenagrionidae	Fingernail Clams Sphaeridae	CLASS II: Snails Pulmonata	CLASS II: Crayfish Astacidae	CLASS II: Flatworms Planariidae	Crane Flies Tipulidae	Midge Flies Tendipedidae	CLASS III: Leeches Hirudinea	CLASS III: Aquatic Worms Oligochaeta	Total Number	No./Sq. Ft.	Variety of Forms	Percentage of Total Individuals Per Class: % CLASS I	% CLASS II	% CLASS III
				1				1						8	8	5	75	25	0
						1	1				2			31	15	6	87	13	0
				1	5	2					155		11	203	101	8	14	81	5
				1	1	10	10	1	36		8			73	36	9	8	91	
8	4		1								132	1	48	194	97	6	7	68	25
					1								1	13	13	5	84	8	8
				10	1						3		1	77	38	7	81	18	1
									2		34		129	165	165	3	0	22	78
	1			17		31				2	2	1	8	181	181	12	66	29	5
						35		1			1		5	60	60	7	30	62	8
						2	2	2			81		93	193	96	7	7	45	48
						41	3			1	3		38	91	91	8	5	53	42
	1		5				1				3		4	117	117	8	94	3	3

A

TABLE 2. (Cont.) CLASSIFICATION and COMPOSITION of BENTHIC SAMPLES, LITTLE KA

LITTLE KANAWHA BASIN Stations	Station Number LK	Number of Samples	CLASS I													CLASS II				
			Caddisflies Hydropsychidae	Philopotamidae	Leptoceridae	Mayflies Baetidae	Heptageniidae	Ephemeridae	Hellgrammites Corydalidae	Biting Midge Ceratopogonidae	Gill Snails Ctenobranchiata	Clams Unionidae	Beetle Larva Elmidae	Damselflies Coenagrionidae	Fingernail Clams Sphaeriidae	Snails Pulmonata	Crayfish Astacidae	Flatworms Planariidae	Crane Flies Tipulidae
Goose Creek	17	1	4			12	3						1		11	9			1	
Little Kanawha River	18	2	15			2	5													
Little Kanawha River	19	2																		

ON and COMPOSITION of BENTHIC SAMPLES, LITTLE KANAWHA RIVER BASIN

CLASS I						CLASS II						CLASS III						Percentage of Total Individuals Per Class		
Ephemeridae	Hellgrammites Corydalidae	Biting Midge Ceratopogonidae	Gill Snails Ctenobranchiata	Clams Unionidae	Beetle Larva Elmidae	Damselflies Coenagrionidae	Fingernail Clams Sphaeriidae	Snails Pulmonata	Crayfish Astacidae	Flatworms Planariidae	Crane Flies Tipulidae	Midge Flies Tendipedidae	Leeches Hirudinea	Aquatic Worms Oligochaeta	Total Number	No./Sq. Ft.	Variety of Forms	% CLASS I	% CLASS II	% CLASS III
					1	11	9			1				4	45	45	8	42	49	9
												7		1	30	15	5	74	21	4
														10	10	5	1	0	0	100

TABLE 3 Little Kanawha Basin Fish Kills, 1964-1966

STREAM	NEAREST BENTHIC SAMPLING STATION	LOCATION	DATE OF KILL	OPERATIONS INDICATED AS RESPONSIBLE FOR KILL	ESTIMATED NUMBER OF FISH KILLED
Reedy Creek	12	Reedy, W. Va.	11-23-64	Wood Processing	41,118
Little Kanawha River	4	Glenville, W. Va.	9-15-65	Petroleum	1,000
Reedy Creek	12	Reedy, W. Va.	9-28-65	Wood Processing	250
Cedar Creek	6	Cedarville, W. Va.	12-4-65	Mining	500
Little Kanawha River	19	Parkersburg, W. Va.	8-11-66	Chemicals	2,000
Reedy Creek	12	Reedy, W. Va.	11-7-66	Wood Processing	25,000
TOTAL					69,868

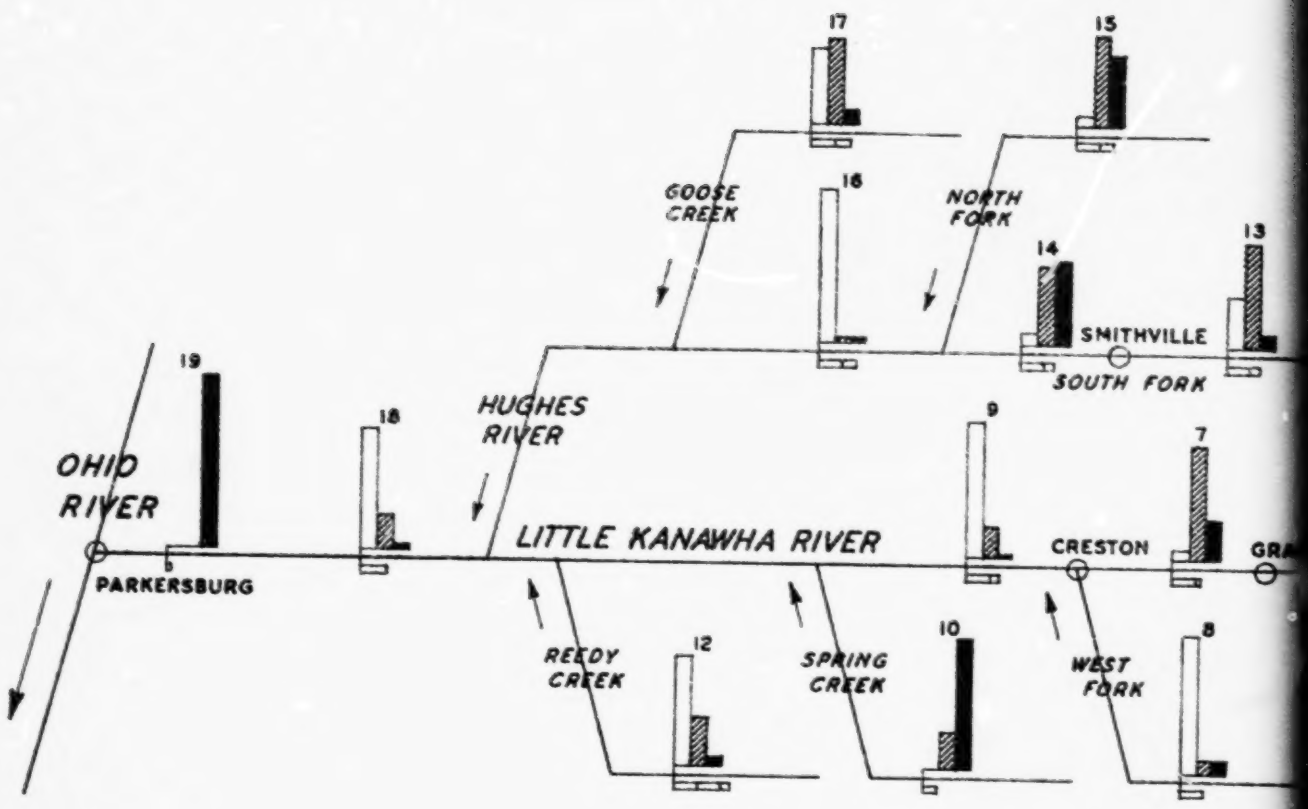
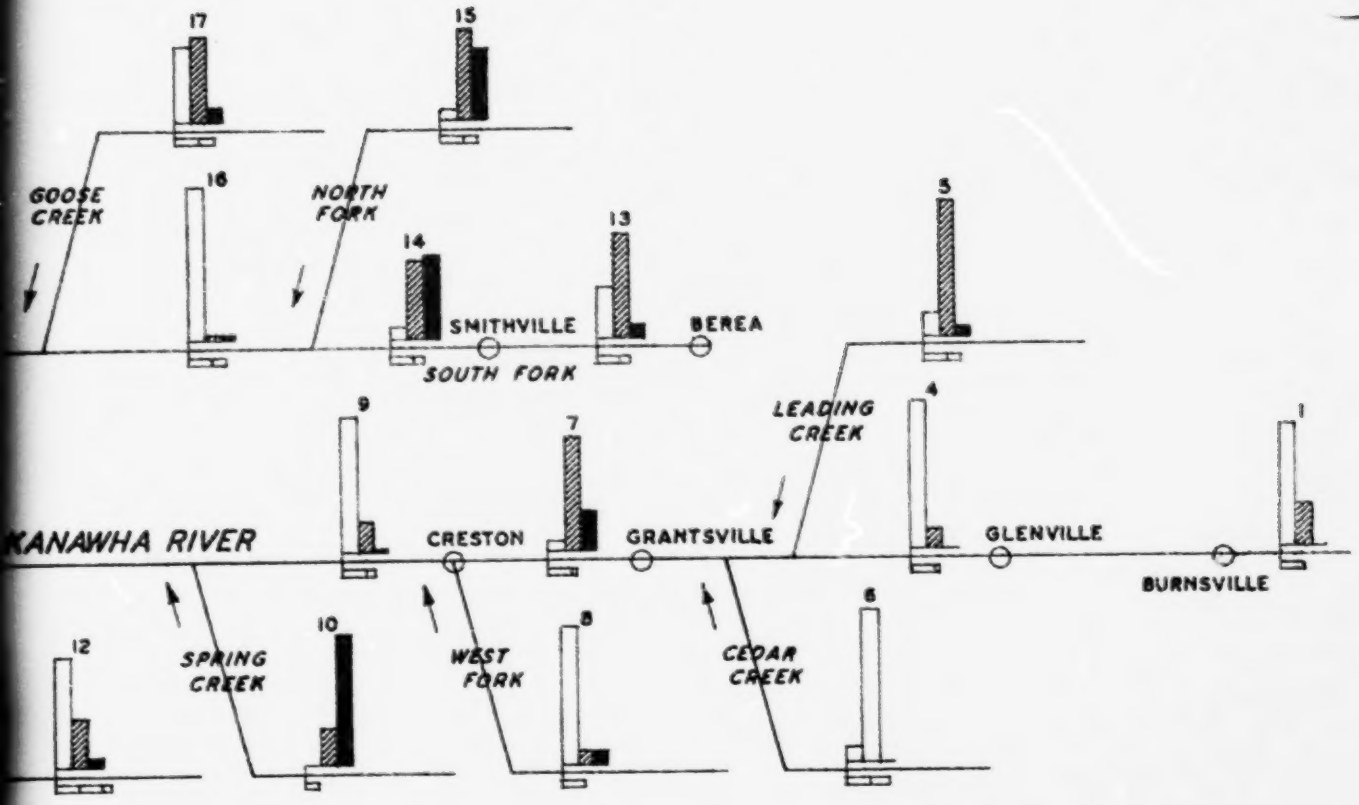


FIGURE 2. LITTLE KANAWHA RIVER DRAINAGE
Percentage Composition of Benthic Samples

B

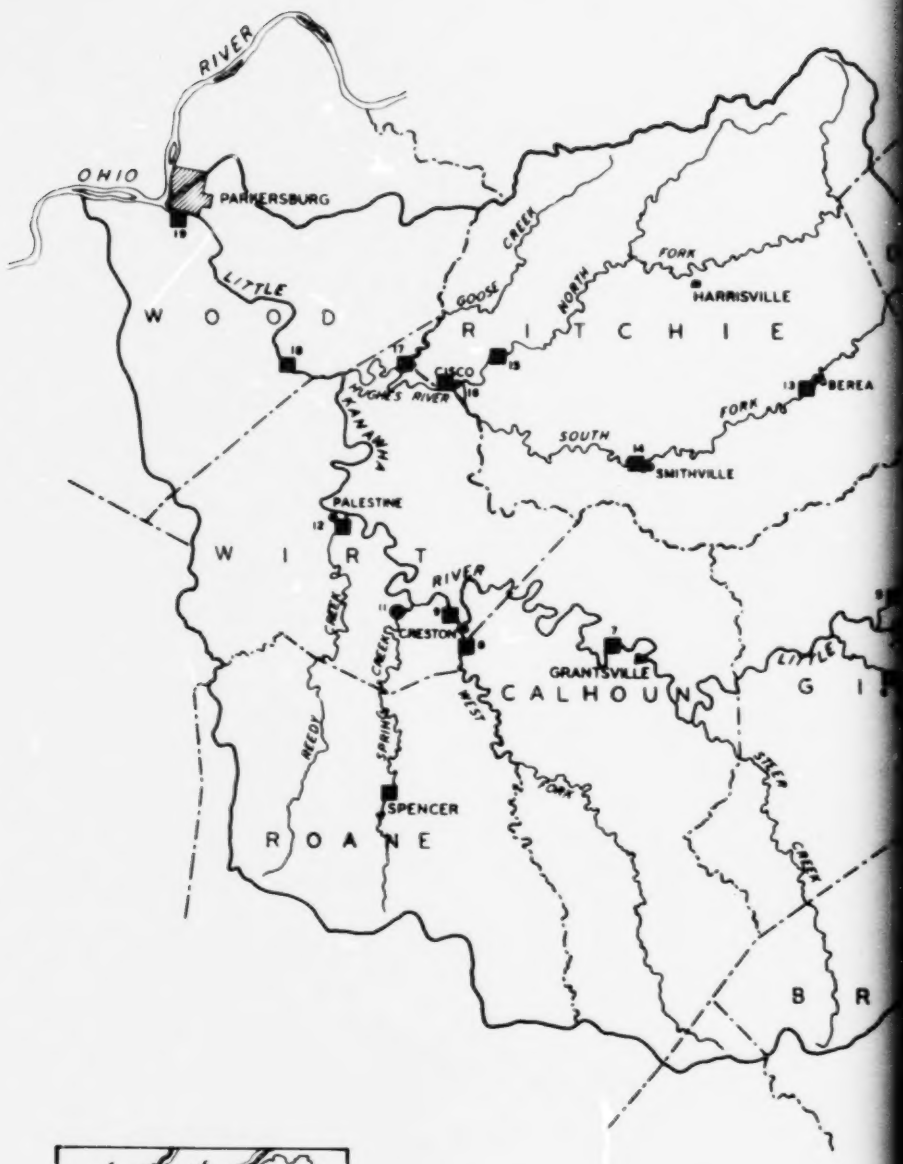


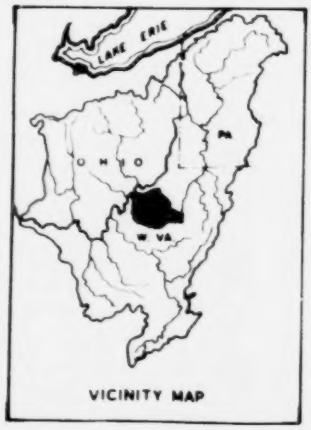
— KEY —

LITTLE KANAWHA RIVER DRAINAGE

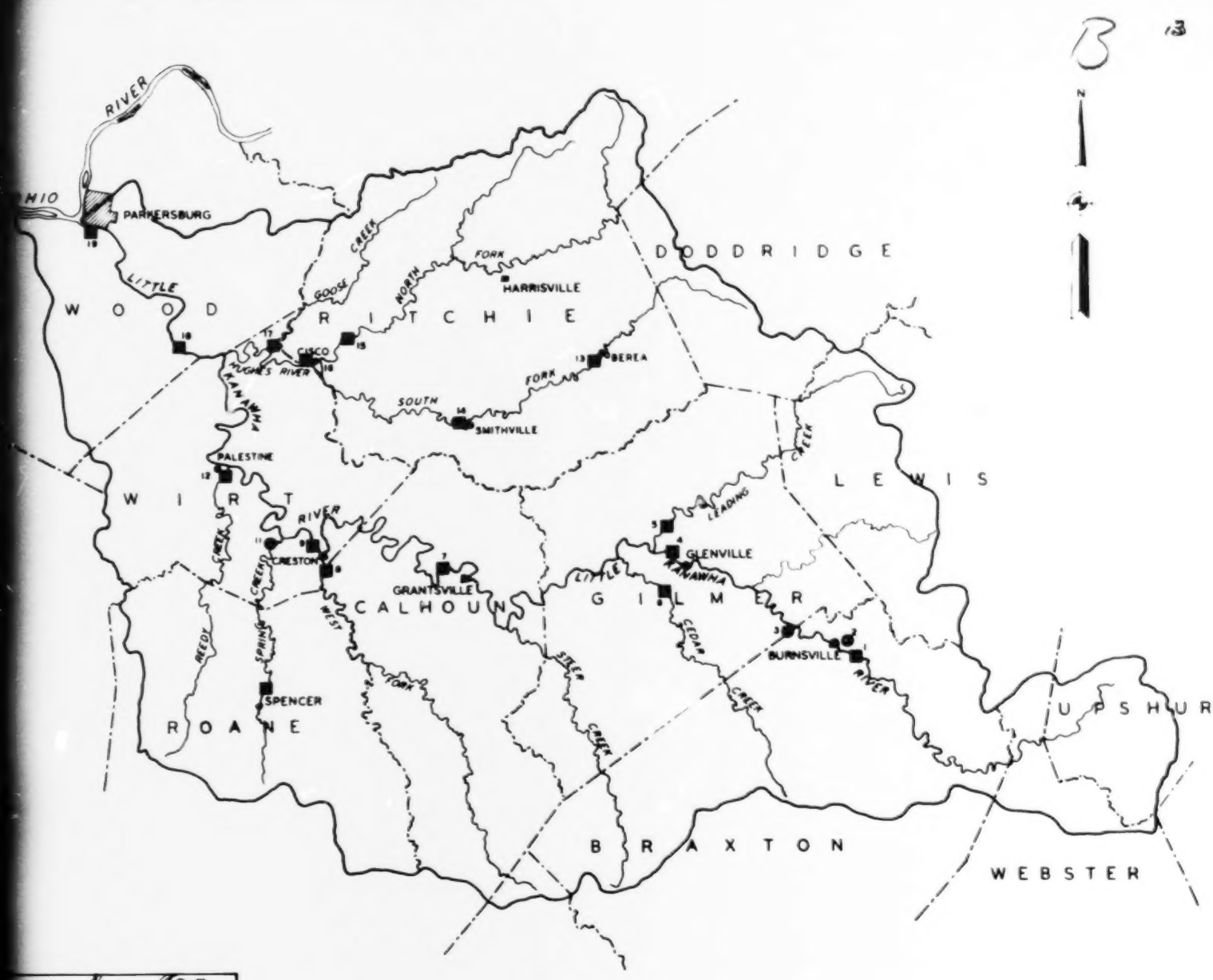
Composition of Benthic Samples

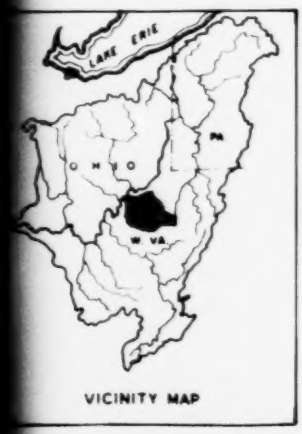
A





VICINITY MAP





LITTLE KANAWHA RIVER BASIN

BIOLOGICAL SAMPLING STATION LOCATIONS

UNITED STATES DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
OHIO BASIN REGION - WHEELING FIELD STATION

FIGURE 3